2021 National Hydrologic Assessment

Released on March 18, 2021

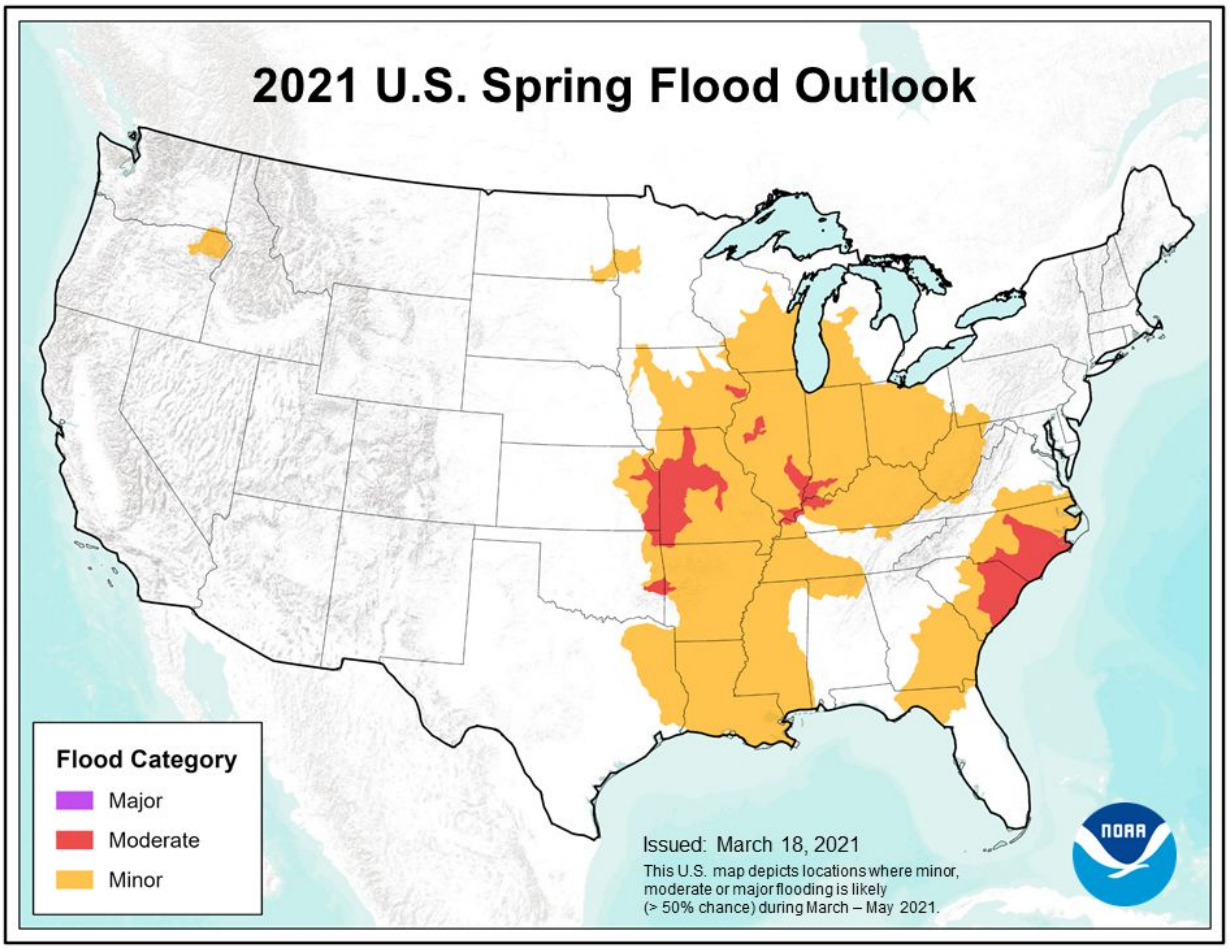

Figure 1: National Spring Flood Risk defined by risk of exceeding Minor, Moderate, and Major Flood Levels.

Executive Summary

The 2021 National Hydrologic Assessment offers an analysis of flood risk, water supply, and ice break-up and jam flooding for spring 2021 based on late summer, fall, and winter precipitation, frost depth, soil saturation levels, snowpack, current streamflow, and projected spring weather. NOAA's network of 122 Weather Forecast Offices, 13 River Forecast Centers, National Water Center, and other national centers nationwide assess this risk, summarized here at the national scale.

This spring season, approximately 82 million people are at risk for flooding in their communities, with nearly 9 million at risk for moderate flooding.

Overall, a reduced risk of spring flooding exists this year primarily due to a mainly dry fall and winter, along with limited snow still remaining on the ground. Major flooding is not expected this spring season. Minor to moderate flooding is ongoing across portions of the Lower Missouri River Basin with the flood risk predicted to continue through spring. The exception to the reduced risk is over the Coastal Plain of the Carolinas and Lower Ohio River Basin where flooding is predicted this spring, driven by above normal precipitation over the winter months, which has led to ongoing flooding, elevated streamflows, and highly saturated soil conditions. This wet pattern is expected to continue across the Coastal Plain of the Carolinas and Lower Ohio River Basin through spring, making these regions vulnerable to spring flooding.

Current water supply forecasts below to much below normal across much of the southwestern United States, southern Oregon and Idaho, into eastern slopes of the Rockies due to below to much below normal snowpack, coupled with ongoing widespread drought.

The Alaska spring ice break-up flood potential is above normal for the Kuskokwim River, as well as rivers along Turnagain Arm, Gulf of Alaska, and northern Southeast Panhandle due to above normal cumulative freezing degree days and/or slightly above to much above normal snowpack.

The predicted spring flood risk across the majority of the Mississippi River Basin is anticipated to result in a near normal hypoxic zone in the northern Gulf of Mexico this summer. A near normal hypoxic zone is also predicted in the Chesapeake Bay. These predictions are based on

the assumption of typical summer conditions and the absence of major disruptive events, such as tropical storms or drought.

Heavy, Convective Rainfall and Flooding

The information presented in this report focuses on spring flood potential, using evaluation methods analyzed on the timescale of weeks to months, not days or hours. Heavy rainfall at any time can lead to flooding, even in areas where the overall risk is considered low. Rainfall intensity and location can only be accurately forecast days in the future, therefore flood risk can change rapidly. Stay current with flood risk in your area with the latest official watches and warnings at weather.gov. For detailed hydrologic conditions and forecasts, go to water.weather.gov.

NOAA's Long Range River Flood Risk Assessment

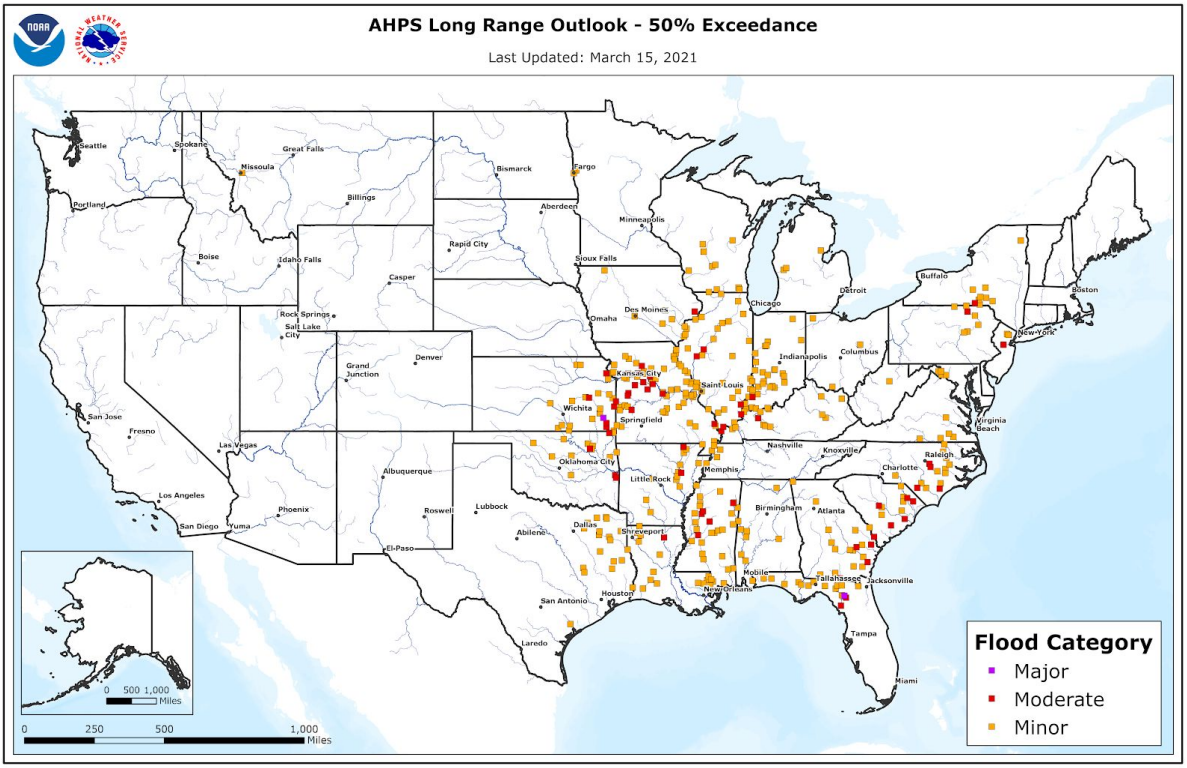

Figure 2: Greater than 50% chance of exceeding minor, moderate, and major river flood levels during Spring

At the request of national partners, including the Federal Emergency Management Agency (FEMA) and the US Army Corps of Engineers (USACE), the National Oceanic and Atmospheric Administration (NOAA) continues its improved decision support services with the "Long Range River Flood Risk" web page available at: https://water.weather.gov/ahps/long_range.php. Stakeholders can access a single, nationally consistent map depicting the 3-month risk of minor, moderate, and major river flooding as shown in Figure 2. This risk information is based on NOAA's Ensemble Streamflow Prediction (ESP) and Hydrologic Ensemble Forecasting System (HEFS), which are generated for approximately 2,600 river and stream forecast locations across the nation. With this capability, stakeholders can quickly view flood risk predicted to affect their specific area of concern. The Long-Range River Flood Risk improves the value of the National Hydrologic Assessment by clearly and objectively communicating flood risk at the local level.

The sections below quantify river flood risk based on the river location having a 50% or more likelihood of exceeding minor, moderate, or major flood levels. The National Weather Service (NWS), in coordination with local officials, defines flood levels for each of its river forecast locations, based on the impact over a given area. The flood categories are defined as follows:

- Minor Flooding: Minimal or no property damage, but possibly some public threat (e.g., inundation of roads).
- Moderate Flooding: Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations.
- Major Flooding: Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.
- Record Flooding: Flooding which equals or exceeds the highest stage or discharge observed at a given site during the period of record. The highest stage on record is not necessarily above the other three flood categories – it may be within any of them or even less than the lowest, particularly if the period of record is short (e.g., a few years).

Missouri River Basin

Minor to moderate flooding continues across portions of the Lower Missouri River Basin as of issuance due to rounds of rainfall in mid March; however, a reduced flood risk generally exists this spring for much of the Missouri River Basin. The reduced flood risk exists mainly due to dry conditions over the winter months, which is evident given ongoing widespread drought for much of upper and middle portions of the basin and below normal snow water equivalent observed this winter. The potential for minor to moderate flooding is predicted to continue across portions of the Lower Missouri River Basin this spring.

In the Upper Missouri River Basin, mountain snow water equivalent is near normal along the Rockies. As such, mountain snowmelt alone will not be a significant driver of flooding this spring. Snow water equivalent over the Plains of the middle and lower portions of the basin has been below normal and negligible, further lowering the risk of spring flooding.

A reduced risk of break-up ice jam flooding exists for upper and middle portions of the basin although ice still remains in the rivers. The risk is considered below normal as dry conditions and below normal snowpack will limit runoff and above normal temperatures currently in place are gradually melting river ice.

In eastern Kansas, minor to isolated moderate flooding is predicted particularly over the Lower Kansas and Little Osage River basins. In Missouri, as with typical years, widespread minor to moderate flooding is predicted within several tributary basins to the Missouri River mainstem, including the Blackwater, Lamine, Grand, Gasconade, and Osage River basins. Minor flooding is expected along the Missouri River mainstem downstream of Kansas City.

Southeastern United States

An elevated risk of widespread minor to moderate flooding exists over the Coastal Plain of the Carolinas. Above normal precipitation observed this winter through mid March (125 to 200% of normal) has led to saturated soil conditions and above to much above normal 28-Day average streamflows. Moderate flooding is possible across the Neuse and lower Cape Fear River basins in North Carolina, the lower Pee Dee River Basin in the Carolinas, and the lower Santee and Edisto River basins in South Carolina.

Ohio, Cumberland, Tennessee River Valleys, and the Lake Erie Region

Widespread minor flooding is ongoing or soon forecast across the Lower Ohio and western Tennessee River basins and their tributaries as of issuance due to rounds of heavy rain that fell across the southern Ohio and Tennessee River basins late February into mid March. These rainfall events resulted in isolated major and even record flooding (Kentucky River Basin), saturated near-surface soils, and above to much above normal 28-Day average streamflows. Most of the abnormally high snow accumulation observed in winter over parts of the Ohio River Basin melted with these rainfall events, with the exception of lingering snow water equivalent (2 to 4 inches) over the northeastern headwaters in southwestern New York, northwestern Pennsylvania, and northeastern West Virginia. Reservoirs along the Ohio River mainstem are generally near the top of the conservation pool with flood storage still readily available.

Given existing wet conditions, an above normal risk of additional minor to moderate flooding is predicted especially over the lower half of the Ohio River Basin early spring. Furthermore, spring convective storms typical for this area could potentially induce additional moderate to isolated major flooding, especially in southeastern Illinois, southern Indiana, and Kentucky. However, flooding is predicted to be less severe than this winter.

In the Lower Ohio River Basin over southeastern Illinois, southern Indiana, and western Kentucky, minor to isolated moderate flooding is predicted in the Lower Wabash, Little Wabash, Patoka, lower Green River basins, as well as the Lower Ohio River mainstem below Louisville. In the Tennessee River Basin, minor to isolated moderate flooding cannot be ruled out this spring. Streams in Ohio, Pennsylvania, and western New York draining into Lake Erie may experience localized backwater flooding due to record elevated lake levels, especially in response to high winds from the north pushing water inland.

Upper Mississippi River, the Red River of the North Basins, and the Lake Michigan Region

Widespread minor to isolated moderate flooding is forecast across southern portions of the Upper Mississippi River Basin as of issuance due to heavy rainfall in mid March. However, a reduced risk of spring flooding is generally predicted across much of the Upper Mississippi River, Souris, and Red River of the North basins although widespread minor to isolated moderate flooding is predicted across southern portions of the Upper Mississippi River Basin. Many of these northern basins have been abnormally dry or are experiencing drought, driven

by below normal winter precipitation, leading to below to much below normal snow water equivalent. In contrast to these basins, above normal snow water equivalent fell over southern portions of the Upper Mississippi River Basin, from northwestern Iowa into northern Illinois and southern Wisconsin. The snow has since melted gradually, and rivers have risen and led to isolated flooding. Isolated moderate flooding is predicted along the lower Wapsipinicon Basin in Iowa, and the lower Illinois River Basin in Illinois. Of note, convective storms typical of the spring season can further lead to widespread moderate and isolated major flooding in southern portions of the Upper Mississippi River Basin.

Frost depth is minimal across much of southern portions of the Upper Mississippi River Basin, which will lower runoff and associated flood potential. Despite above-freezing temperatures observed in early March starting to thaw the near-surface soil layer, a frost depth of 2 to 4 feet still remains over the Upper Mississippi River, Souris, and Red River of the North basins due to abnormally cold air in February. However, anomalously dry conditions and limited snow accumulation across these basins will hinder overall water available for runoff. A below normal to normal risk of break-up ice jam flooding exists due to above normal temperatures observed during the beginning of winter and early March preventing the formation of additional river ice.

Arkansas and Red River Basins

Scattered minor to moderate flooding is ongoing or soon forecast as of issuance over eastern portions of the Arkansas and Red River basins due to heavy rainfall in mid March. However, a near-normal spring flood risk is predicted with scattered minor to isolated moderate flooding across the majority of the Arkansas and Red River basins with the exception of a below normal flood risk across the upper Arkansas River Basin. This near-normal to below normal risk is driven by below normal winter precipitation and ongoing drought over upper portions of the basin, which is predicted to persist through spring. In southeast Kansas and northeast Oklahoma, minor to moderate flooding is predicted across the Neosho River Basin. In eastern Oklahoma and western Arkansas, minor to moderate flooding is predicted across the Poteau River Basin.

Lower Mississippi River Basin and its Tributaries

Scattered minor flooding is ongoing, along with isolated moderate flooding forecast, as of issuance from northern Louisiana to northeastern Arkansas of the Lower Mississippi River Basin and the Lower Mississippi River mainstem due to much above normal rainfall in February into

mid March, combined with routed flows from upstream and anomalous snowmelt runoff, resulting in saturated near-surface soils. Ongoing flooding is anticipated to continue into the spring with a near normal risk of minor to isolated moderate flooding across much of the Lower Mississippi River Basin and its tributaries.

In eastern Arkansas and western Tennessee, minor flooding is predicted to continue through spring, along with a potential of isolated moderate flooding. In Louisiana and Mississippi, minor to isolated moderate flooding cannot be ruled out over portions of the Atchafalaya and Big Black River basins while widespread minor river flooding is predicted across the Pearl River Basin.

Texas and Southwest Louisiana

An elevated risk of minor river flooding exists this spring over the Neches River Basin in eastern Texas and the Sabine and Sulphur River basins of eastern Texas and western Louisiana. This is driven by above normal soil water content and near normal streamflows from above normal precipitation in February. This wet pattern has resulted in reservoirs in eastern Texas at generally near full conservation levels. A below normal spring flood risk is predicted for the remainder of the region with ongoing drought and dry spring prediction.

Northeast

A near normal spring flood risk exists for much of the Northeast region driven by near normal conditions. The spring flood potential is below normal from portions of Vermont and northern New Hampshire into Maine as mainly dry conditions (below normal soil moisture, groundwater levels, and streamflows) in these areas should offer sufficient storage for snowmelt runoff without widespread flooding despite an above normal precipitation chance for portions of the region this spring.

The potential for break-up ice jam flooding is near to below normal across much of the region. Although ice jams are in place over northern portions of the region, and river ice is likely to remain in place across much of Maine through early April, the ice thickness has been slightly thinner this year due to a warm start of winter. Combined with a below normal risk of widespread runoff this spring, break-up ice jam flooding risk is further reduced.

Middle Atlantic Region: Virginia, Maryland, Washington D.C., Pennsylvania, Delaware, and south-central New York

A near normal risk of flooding exists for most of the Mid-Atlantic Region this spring. An extended period of above normal to much above normal precipitation this winter in the southern Mid-Atlantic Region has resulted in high soil moisture content, above to much above normal groundwater levels, and above normal streamflow across portions of Virginia and the Delmarva Peninsula. Meanwhile, snow remains in small portions of southern New York and northern Pennsylvania. Although the seasonal prediction favors above normal precipitation, dry conditions this past fall should mitigate the risk of widespread flooding. However, the convective rainfall typical for this area could lead to isolated moderate river flooding this spring across the Mid-Atlantic Region. Break-up ice jam flooding is not predicted this year with the absence of ice in the rivers of the regions.

Western U.S.

Mid-March is usually still too early to determine final spring flooding potential across the western United States induced by snowmelt since snowpacks at higher elevations are expected to persist and could potentially build over the next several months. However, due to below to much below normal snowpack over much of the West, the probability of widespread snowmelt induced flooding is predicted to be below normal at this time.

There is still time left for snow accumulation and for the spring flood potential to change across the West. Even in areas where the spring flood risk is near to below normal, some smaller streams and flood prone areas may experience minor flooding with a sudden warm-up, the occurrence of heavy rain, or thunderstorms over those basins. Rapid warming can lead to elevated melt rates. During the snowmelt season, when rivers and streams are flowing at or near capacity, any precipitation can increase the risk of flooding.

The risk of spring flooding is near normal to below normal across much of the Pacific Northwest. In Washington, a slightly above normal risk of flooding exists over the east side of the north and central Washington Cascades into the Okanogan Valley, driven by above to much above normal snow water equivalent for much of the state. However, any river rises from snowmelt in the area may not peak until after this outlook period. In northeast Oregon and southeast Washington, an above normal spring flood risk exists for rivers and creeks draining the Blue and Wallowa Ranges driven by above normal snow accumulation in February. In

Idaho, wildfire burn scars can have a significant impact on local flood potential during spring snowmelt.

In general, the risk of spring flooding due to snowmelt alone is below normal across much of the Southwest, southern Oregon, southern Idaho, and along the central and southern Rockies due to below to much below normal snowpack at the time of issuance.

Water Supply

Western U.S.

Water supply forecasts are produced by the River Forecast Centers in the western United States. Forecasts reflect current hydrologic conditions including snowpack, soil moisture, weather forecasts, and climate information. As these conditions change, especially over the next couple months, forecasts will be updated to reflect these changes at the Western Water Supply Forecasts page.

Northwest

The majority of the Northwest is forecast to experience normal to above normal water supply through September due to overall above normal mountain snowpack across Washington, northern through central Oregon, and much of Idaho. Southern portions of the region are forecast to experience below normal water supply through the remainder of the water year resulting from below normal mountain snowpack across southern Oregon and southern Idaho. As of issuance, mountain snowpack is near to above normal, Water supply forecasts for April through September runoff volume across the Northwest are summarized below:

- Upper Columbia basin: 95 to 110% of normal
- Snake River basin: 25 to 90% of normal
    - Headwaters along the Wyoming border: 75 to 90% of normal
    - Big and Little Wood basins and Big Lost River Basin in Idaho: 25 to 50% of normal

- Columbia River at The Dalles (a good index of conditions across the Columbia Basin): 90 to 95% of normal
- Northeast Oregon basins: 95 to 130% of normal
- Northwest Oregon basins: 90 to 100% of normal
- Southern and central Oregon basins: 40 to 85% of normal
- Northwestern Washington basins: 105 to 110% of normal
- Southwestern Washington basins: 100 to 110% of normal
- Eastern Washington, northern Idaho, and western Montana basins: 90 to 125%

California

Below to much below normal water supply runoff volumes are forecast in California for April through July. Mountain snowpack across the higher terrain range of California is below normal ranging from 60% of normal in the northern Sierra Nevada, 70% of normal in the central Sierra Nevada, and 45% of normal in the southern Sierra Nevada, coupled with ongoing state-wide meteorological drought. Further north across the southern Cascades, snowpack ranges 30 to 100% of normal. Precipitation totals since the beginning of the water year have ranged from 35% to 65% of normal with many regions in California observing five consecutive months of below normal precipitation. Runoff volumes forecast for April through September throughout the state as summarized below:

- Lower Klamath River Basin: 30 to 80% of normal
- Sacramento River Basin: 30 to 50% of normal
- San Joaquin River Basin: 10 to 50% of normal
- Northern California Coast: 35 to 80% of normal
- Central California Coast including San Francisco Bay: 5 to 40% of normal
- Southern California Coast: 10 to 45% of normal

Nevada

Below normal water supply runoff is forecast for April through July in Nevada due to generally below normal snowpack. Snowpack across Nevada is ranging from 80% in the Ruby Mountains in the northeast to 60 to 90% of normal across the lee side of the central Sierra Nevada with portions of north central Nevada near normal. Below normal streamflows continue along with below normal reservoir storage especially on the lee side of the Sierra Nevada in the presence of the ongoing, state-wide, long-term drought. The April through September runoff forecasts in Nevada as follows:

- Rivers and streams of the eastern Sierra: 20 to 50% of normal
- Humboldt Basin: 15 to 70% of normal

Colorado River and Great Basins

Much below normal precipitation this fall and winter along with near-record dry soil moisture conditions at the beginning of the winter season is negatively impacting water supply forecasts across the Colorado River Basin and eastern Great Basin. Broadly, snow water equivalent is around 75 to 85% across the Upper Colorado River Basin. The April through July water supply runoff forecasts for the Upper Colorado River Basin are listed below:

- Yampa and White Basin: 55 to 75% of normal
- Upper Colorado Mainstem: 40 to 75% of normal
- Gunnison Basin: 40 to 70% of normal
- Upper Green Basin: 55 to 80% of normal
- Dolores and San Miguel Basin: 40 to 50% of normal
- San Juan Basin: 35 to 75% of normal

Natural inflow forecasts between April and July for some of the major reservoirs in the Upper Colorado River Basin include the following:

- Fontenelle Reservoir 65% of normal
- Flaming Gorge: 55% of normal

- Blue Mesa Reservoir: 70% of normal
- McPhee Reservoir: 50% of normal
- Navajo Reservoir: 60% of normal
- Lake Powell: 50% of normal

Snow water equivalent values across the eastern Great Basin generally range between 70 and 85% of normal while values across the Lower Colorado River Basin ranges between 15 and 65% of normal as of issuance. The March through May water supply forecasts for the eastern Great and Lower Colorado River basins are listed below:

- Eastern Great Basin
    - Bear: 35 to 85% of normal
    - Weber: 30 to 50% of normal
    - Six Creeks: 45 to 60% of normal
    - Provo/Utah Lake: 40 to 60% of normal
    - Virgin: 35 to 75% of normal
    - Sevier: 10 to 85% of normal
- Lower Colorado River Basin
    - Little Colorado and Upper Gila: 20% of normal
    - Salt: 20% of normal
    - Verde: 35% of normal

Water Resources East of the Rockies

The seasonal prediction favors a chance of warmer and drier than normal conditions through spring across the Southern Rockies and Southern Plains, which will likely allow for drought to persist across the western portions of the region and expansion of drought across central Kansas, Oklahoma, and Texas and southern Florida. Across the rest of the region, near to above

normal winter precipitation has helped soil moisture and streamflow remain normal to above normal.

Upper Missouri River Basin

Below normal water supply is forecast across the Upper Missouri River Basin despite generally near normal snowpack due to below normal soil moisture. The current snowpack is generally above normal in smaller basins across Montana but decreases southward to below normal into Wyoming, and northeast Wyoming. The April through September water supply runoff forecasts for the Upper Missouri River Basin are listed below:

- Upper Missouri River Basin
    - St. Mary River: 65% of normal
    - Upper Missouri Basin above Fort Peck, Montana: 85 to 95% of normal
- Yellowstone Basin
    - Yellowstone River above Sidney, Montana: 80% of normal
    - Tongue Basin: 70% of normal
    - Powder River: 50% of normal
- Platte Basin
    - North Platte River at Seminoe Reservoir: 60% of normal
    - South Platte Basin at South Platte: 70% of normal
    - Remainder of the South Platte Basin: 70% of normal

Upper Arkansas River Basin

Below normal water supply is forecast across the headwaters of the Upper Arkansas River Basin. Ongoing, widespread drought is predicted to persist across the area with the possible expansion of drought into downstream of the basins through spring. Coupled with the dry conditions, below normal snowpack is lowering the water supply forecasts in the area. The April through September water supply runoff forecasts for the Upper Arkansas River Basin are listed below:

- Arkansas River at Salida: 75 % of normal
- Arkansas River above Pueblo Reservoir: 75 % of normal
- Cucharas River near La Veta: 90 % of normal
- Huerfano River near Redwing: 90 % of normal
- Purgatoire River at Trinidad: 90 % of normal

Upper Rio Grande Basin

Below normal water supply runoff is forecast for the Upper Rio Grande Basin headwaters with much below normal forecast expected downstream of the Rio Grande near Santa Fe, New Mexico. Ongoing, widespread drought is predicted to continue across the area through spring. Additionally, the current snowpack of the basin is generally much below normal with the exception of the Rio Grande Headwaters where snowpack is near normal. Selected seasonal water supply forecasts from April through September are listed below:

- Rio Grande Headwaters: 70 % of normal
- South Fork Rio Grande River: 70 % of normal
- Pecos River near Santa Rosa: 60 % of normal

Northeast

No widespread water supply issues are predicted over the Northeast region this spring. Reservoir storage across the region is generally near normal to below normal, mainly driven by below normal winter precipitation, with areas of ongoing moderate drought across upstate New York, eastern Vermont, and southwestern New Hampshire. However, the remaining snow water equivalent and a greater chance of above normal precipitation this spring is sufficient to replenish groundwater and reservoir storage.

Mid-Atlantic

Reservoir storage across the Mid-Atlantic region is generally near normal for this time of year, and water supply shortages are not anticipated this spring across the Mid-Atlantic. However, if

below normal precipitation this spring does occur across New York and Pennsylvania, some scattered water supply problems could return this summer, as some of this area is not fully recovered from dry conditions observed last summer and fall.

Alaska Spring Ice Breakup Outlook

The Alaska spring ice breakup flood potential is forecast to be above normal for the Kuskokwim River, as well as rivers along Turnagain Arm, Gulf of Alaska, and northern Southeast Panhandle. Below normal potential exists along North Slope rivers and the Koyukuk Rivers while near normal potential exists along the Tanana, Yukon, and Copper Rivers and other major rivers across Alaska. This outlook is based on observed snowpack, ice thickness reports, and long-range air temperature forecasts. It is important to remember that while Alaska has experienced mostly mild winters for the past decade, that 'normal' is defined over a longer period. Normal flood potential may be higher than in recent memory.

River Ice

March ice thickness data are available for a limited number of observing sites in Alaska. Late February and early March measurements indicate that ice thickness is near normal across the state with an exception being at the Yukon River near Galena, which is below normal. Cumulative freezing degree days are above normal at sites along the Gulf of Alaska (i.e. colder than normal) and the northern Southeast Panhandle, but normal or somewhat below normal elsewhere.

Snowpack

Analysis of the March 1st snowpack by the Natural Resources Conservation Service (NRCS) indicates greater than normal snowpack in the Kuskokwim Basin, 150% of normal. The Koyukuk River basin and the North Slope have snowpacks significantly below normal. The Yukon and Copper River basins and the rest of the Interior have relatively normal snowpacks. Snowpacks in basins along the Gulf of Alaska and the northern Southeast panhandle are significantly above normal in some locations.

Climate Outlook

The most important factor determining the severity of ice breakup remains the weather during April and May. Dynamic breakups with a high potential for ice jam flooding typically require cooler than normal temperatures for most of April followed by an abrupt transition to warm, summer-like temperatures in late April to early May.

The outlook for March suggests an increased chance of below normal temperatures over southern Alaska and above normal temperatures over the North Slope. The longer, 3-month outlook, which includes April, May, and June, also indicates increased chances of below normal temperatures in southern Alaska, and above normal temperatures in northern and northwestern Alaska, including the North Slope.

Spring Flood Outlook and Implications for Gulf of Mexico and Chesapeake Bay Hypoxia

In the northern Gulf of Mexico a large area of low-oxygen forms in the bottom waters during the summer months, often reaching in excess of 5,000 square miles. This area of low-oxygen, otherwise known as the “dead zone”, is strongly influenced by precipitation patterns in the Mississippi-Atchafalaya River Basin (MARB), which drains over 41% of the contiguous United States. Changes in precipitation will influence river discharges into the Gulf, which carry the majority of nutrients helping to fuel the annual dead zone, so examining spring flood risk in the MARB can provide a useful indicator of the possible size of the dead zone during the summer.

The predicted reduced risk of flooding across the MARB is anticipated to result in near normal springtime discharges of nutrients and freshwater from the basin. These predictions create conditions for a near normal or average hypoxic zone in the northern Gulf of Mexico this summer. Flood conditions, should they occur, may lead to higher than normal springtime discharges and promote formation of a larger hypoxic area. This cause and effect relationship can be confounded by weather events, such as tropical storms and hurricanes, which can locally disrupt hypoxia formation and maintenance as happened last year.

In the Chesapeake Bay, recurring summer hypoxia has also been linked to nutrient loadings and river discharge, especially from the Susquehanna and Potomac Rivers. The predicted flood risk

is anticipated to result in average discharges over these basins and lead to a near normal or average hypoxic zone for the Chesapeake Bay. This prediction is based on the assumption of typical summer conditions and the absence of major disruptive events, such as tropical storms and hurricanes or drought conditions.

The spring flood outlook provides an important first look at some of the major drivers influencing summer hypoxia in the Gulf of Mexico and Chesapeake Bay. In early June, the measured river discharge amounts and corresponding nutrient concentrations will be available from the U.S. Geological Survey. This information is used by NOAA and others to release annual dead zone forecasts for the Gulf of Mexico and Chesapeake Bay. In the summer, the dead zone sizes will be measured and compared against the predictions. Hypoxia forecast models that evaluate the size of the dead zone based on causative factors such as watershed nutrient loading deliver critical information to the Gulf of Mexico/Mississippi River Watershed Nutrient Task Force and Chesapeake Bay Program to assess the effectiveness of watershed nutrient reduction efforts to reduce the size of their respective dead zones. The National Weather Service and Ocean Service are working with States to develop new tools to forecast runoff risk which should help limit nutrient runoff to the Gulf of Mexico, Chesapeake Bay, Great Lakes and other regions by identifying the optimal times for fertilizer application within these watersheds.

NOAA's Role in Flood Awareness and Public Safety

Floods kill an average of 90 people each year in the US. The majority of these cases could have been easily prevented by staying informed of the flood threat and following the direction of local emergency management officials.

To help people and communities prepare, NOAA offers the following flood safety tips:

- Determine whether your community is in a flood-risk area and continue monitoring local flood conditions at https://water.weather.gov.
- Learn what actions to take to stay safe before, during and after a flood at https://www.weather.gov/safety/flood and https://www.ready.gov/floods.

- Visit https://www.floodsmart.gov to learn about FEMA's National Flood Insurance Program and for flood preparedness advice to safeguard your family, home and possessions.
- Purchase a NOAA Weather Radio All- Hazards receiver with battery power option to stay informed of quickly changing weather information.
- Study evacuation routes in advance and heed evacuation orders.
- Turn Around, Don't Drown – never cross flooded roads, no matter how well you know the area or how shallow you believe the water to be.

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About This Product

The National Hydrologic Assessment is a report issued each spring by the NWS that provides an outlook on U.S. spring flood potential, river ice jam flood potential, and water supply. Analysis of flood risk integrates late summer, fall, and winter precipitation, frost depth, soil saturation levels, streamflow, snowpack, temperatures, and rate of snowmelt. A network of 122 Weather Forecast Offices and 13 River Forecast Centers nationwide assess the risk summarized here at the national scale. The National Hydrologic Assessment depicts flood risk over large areas, and is not intended to be used for any specific location. Moreover, this assessment displays river and overland flood threat on the scale of weeks or months. Flash flooding or debris flow, which accounts for the majority of flood deaths, is a different phenomenon associated with weather patterns that are only predictable days in advance. To stay current on flood risk in your area, go to water.weather.gov for the latest local forecasts, warnings, and weather information 24 hours a day.